REMARKS

Claims 7-14, and 16-19 are pending in the above identified application. The Examiner has rejected claims 7-14, and 16-19. Applicants have amended claims 7, 11, and 16 to better describe the invention. Applicants herein traverse the Examiner's rejections.

Applicants have amended claims 7, 11, and 16 to include the limitation "reducing the lateral leakage current between the plurality of source-drain metal contacts in the high fill factor image array by depositing a second passivation layer over the first passivation layer." In the office action dated September 19, 2005, the Examiner had objected to a limitation, which had been removed from those claims, that "the second passivation layer suppressing lateral leakage current between collection electrodes." The Examiner indicated that this language is indefinite because "the claims do not define what level of current the lateral leakage is being reduced from or what level of current occurs after the lateral leakage has been reduced." Applicants have, in this amendment, utilized the language "reducing the lateral leakage current between the plurality of source-drain metal contacts . . . ," which avoids the Examiner's objections.

Claim Rejections under 35 U.S.C. § 103

The Examiner has rejected claims 7-19 under 35 U.S.C. § 103 in light of Applicants prior art in view of Ishaque (U.S. Pat. No. 5,288,989) and further in view of Possin (U.S. Pat. No. 5,777,355).

As applicants have pointed out to the Examiner before, the system described in Ishaque is substantially different than that described and claimed in the present application. Ishaque describes

> [a]n avalanche photodiode (APD) [that] has a two tier passivation layer disposed over the silicon APD body. The passivation layer

includes an inorganic moisture barrier layer and an organic dielectric layer.

(Ishaque, abstract). The structure of the optical device described in Ishaque is substantially different from that described and claimed in the present application. As shown in the figure of Ishaque, the optically active element 120 is deposited directly on a transparent conductive contact pad 110. Dual passivation layer, having passivation layers 132 and 134, are deposited over the optically active element 120 with contact 140 formed in contact with optically active portion 120 at contact area 126 through a via formed in passivation layers 132 and 134. Also as shown in the figure, during operation light is incident on the device through transparent conductive contact pad 110 to be detected in optically active area 120. Dual passivation layer 130 is, then, open to atmospheric conditions, which results in application of a moisture barrier layer 134 on top of passivation layer 132 to protect the device.

In contrast, the full fill factor device described in the present application, as shown in Figure 3, is formed on a substrate 42. Conductive pad 144 is formed directly on substrate 42 with conductor 146 formed over the conducting pad 144. Optical element 148 is formed on top of conductor 146. Transparent element 150 is formed over optically active element 148 and separating different individual elements. First passivation layer 156 is formed between conductive pads 144 directly on substrate 42 and second passivation layer 157 is formed directly on first passivation layer 156. Conductor 146 is in contact with conducting pad 144 and over second passivation layer 157. Transparent element 150 is also formed between conducting elements 146 and on second passiviation layer 157. Second passivation layer 157 is closer to the active silicon, conductive element 148, than is first passivation layer 156, which is formed directly on substrate 42. In operation, light enters through transparent conductive layer 154 to be

detected by optically active element 148. Passivation layers 156 and 157 are not open to atmosphere and are not intended to form a moisture or atmospheric barrier layer.

To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on applicant's disclosure. In re Vaeck, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991). (MPEP Sec. 706.02(j))

I. The cited prior art does not teach all of the elements of the claims

1. None of the references teach "reducing the lateral leakage current . . . ."

None of the references teach "reducing the lateral leakage current between the plurality of source-drain metal contacts in the high fill factor image array by depositing a second passivation layer over the first passivation layer," as is recited in claims 7, 11, and 16.

As the Examiner has previously admitted "the AAPA does not discuss using a second passivation layer overlying the first passivation layer to prevent the conducing channels from forming between two pixel electrodes" (Office Action mailed March 4, 2003, pgs 2-3). Ishaque teaches "[a]n avalanche photodiode (APD) [with] a two tier passivation layer disposed over the silicon APD body." (Ishaque, abstract). Ishaque describes that "an avalanche photodiode (APD) includes an APD body, a bottom contact pad, a top contact pad, and a two-tier passivation layer." (Ishaque, col. 3, lines 26-29). As further taught in Ishaque, "[t]he two-tier passivation layer is

disposed over the APD body so as to cover the outer periphery of the APD body except at a selected contact area with the top contact." (Ishaque, col. 3, lines 42-45). Nowhere does Ishaque teach "reducing the lateral leakage current between the plurality of source-drain metal contacts in the high fill factor image array by depositing a second passivation layer over the first passivation layer," as is recited in claims 7, 11, and 16.

Therefore, neither the AAPA nor Ishaque, nor their combination, teaches "reducing the lateral leakage current between the plurality of source-drain metal contacts in the high fill factor image array by depositing a second passivation layer over the first passivation layer," as is recited in claims 7, 11, and 16. Furthermore, Possin fails to cure the defects in the teachings of the AAPA and Ishaque. Possin fails to disclose or suggest reducing lateral leakage current by depositing a second passivation layer on a first passivation layer.

2. None of the references teach "the second passivation layer being thinner than the first passivation layer."

Claims 7, 11, and 16 each recite "the second passivation layer being thinner than the first passivation layer." None of the references teach this feature.

As illustrated in Figure 3 of the present disclosure, the second passivation layer as recited in claims 7, 11, and 16 is the passivation layer that is closest to the detector silicon. Claim 7 recites "depositing a layer of conductive material over the plurality of source-drain metal contacts and the second passivation layer; depositing a first doped a-Si layer as an optically active layer over the layer of conductive material; patterning the first doped a-Si layer and the layer of conductive material to form collection electrodes." Therefore, as claimed, the optically active layer is deposited over a layer of conductive material which has been deposited over the source-drain metal contact and the second passivation layer. The opposite is taught in Ishaque,

as shown in the figure, where the thicker layer passivation layer is deposited on the optically active material (material 120) and the thinner passivation layer is deposited on the thicker passivation layer.

Similarly, claim 11 recites "depositing a layer of conductive material on the plurality of source-drain metal contacts and over the second passivation layer; depositing a first doped a-Si layer as an optically active layer over the layer of conductive material; patterning the first doped a-Si layer and the layer of conductive material to form collection electrodes," and claim 16 recites "depositing a layer of conductive material on the source-drain metal contact, such that the layer of conductive material makes electrical contact with the source-drain metal contact; depositing a first doped a-Si layer as an optically active layer on the layer of conductive material; patterning the a-Si layer and the layer of conductive material to form a collection electrode." The admitted prior art does not include a second passivation layer at all. Possin does not cure the defects in the teachings of Ishaque.

Therefore, claims 7, 11, and 16, as amended, are allowable over Applicants' prior art, Ishaque, and Possin. Claims 8-10, 12-14, and 17-19, which depend from claims 7, 11, and 16, respectively, are then also allowable over the cited prior art.

II. There is no motivation to combine the teachings of Ishaque, Possin, and the AAPA

Ishaque teaches application of a moisture barrier layer. There is no motivation for one of ordinary skill in the art to add a moisture barrier layer to the barrier layer taught in Applicants' prior art. Applicants do not agree or acquiesce in the Examiner's analysis of this issue. The passivation layers taught in Ishaque are exposed to atmosphere and Ishaque teaches a second passiviation layer as an atmospheric barrier layer only. One of ordinary skill in the art would not

be expected to combine the teachings of Ishaque with that of the AAPA to provide a dual passivation layer.

In the office action, on page 10, the Examiner lists five motivations that the two-tier passivation layer of Ishaque provides:

> 1) an electrically insulating barrier, 2) the ability to cover the underlying structure without cracking or inducing stresses that adversely effect the dielectric integrity of the passivating layer, 3) an interface with the passivating layer that has minimal conductivity so that leakage in reverse bias is not degraded, 4) a layer thick enough so that the electric field inside the dielectric layer does not become very large, and 5) protection from degradation due to humidity, moisture, or chemical attack from materials in the environment or present on the wafer during fabrication and over time as the device is exposed to a variety of environments. See Ishaque et al. column 2 lines 3-31.

However, Ishaque further teaches that single passivation layers "have been found to provide a satisfactory passivating layer with regard to several of the desirable characteristics listed above." (Ishaque, col. 2, lines 33-36). The only drawback listed is that "polyimide passivating layers include the poor moisture barrier provided by polyimides." (Ishaque, col. 2, lines 37-38). Therefore, **the only motivation provided in Ishaque is to provide a second passivation layer as a moisture barrier.**

In Applicants' prior art, the barrier layer is fully embedded in the device and there is no need for a moisture barrier. In fact, one skilled in the art would resist a good moisture barrier because of the desire not to trap moisture in the device. Therefore, one skilled in the art would not be motivated to combine the teachings of Ishaque with those of the prior art as suggested by the Examiner. Therefore, claims 7-19 are allowable over the cited prior art because there is no motivation to combine Ishaque with the Applicants' teaching of the prior art.

III. There is no reasonable likelihood of success.

Ishaque teaches providing "moisture-resistant passivation layers adapted for use on arrays of avalanche diodes." (Ishaque, col. 1, lines 10-12). Consequently, Ishaque teaches a passivation "two-tier passivation layer . . . disposed over the APD body so as to cover the outer periphery of the APD body except at a selected contact area with the top contact." (Ishaque, col. 3, lines 42-45). Further, "[t]he passivation layer includes an inorganic moisture barrier layer and an organic dielectric layer." The Examiner contemplates substituting this passivation layer structure with the passivation layer embedded within Applicant's prior art device. In that context, the passivation layer structure would not function as intended by Ishaque et al. In other words, the Examiner contemplates placing a moisture barrier layer embedded within a device where it can not serve its stated function as a moisture barrier layer.

Rebuttal to the Examiner's Comments

The Examiner states that "Applicant's arguments filed 1/13/06 have been fully considered but they are not persuasive." In particular, the Examiner states that

> Applicant has argued that the thicker first passivation layer of Ishaque is deposited on silicon. This argument is not persuasive. First, it is not well understood how the first passivation layer being thicker in argued to be different than what is claimed. The claims recite the second passivation layer being thinner than the first, thus the first being thicker than the second. As such, this argument agrees with the rejection in that the dual passivation layer of Ishaque reads on the first and second passivation layer claimed. Second, it is not understood how the first passivation layer of Ishaque being deposited on silicon has any bearing on whether the rejection of the claimed invention is proper or not. The combination as applied in the rejection, does not rely upon any silicon layers being formed underneath the first passivation layer or not. In the combination, the first passivation layer 132 of

> Ishaque would be formed on substrate 42 and metal contacts 44 of figure 2 of the admitted prior art. This combination is the same as that claimed.

However, it is very relevant in which order the passivation layers are deposited. The Examiner is utilizing Ishaque's two passivation layers to teach the first and second passivation layer claimed by the Applicants here. However, that is not the entirety of the claim and the Examiner has not shown where Ishaque teaches the claimed first and second passivation layers that is lacking in the AAPA. Claim 7, for example, recites "depositing a first passivation layer over the plurality of source-drain metal contacts and the substrate; reducing the lateral leakage current between the plurality of source-drain metal contacts in the high fill factor image array by depositing a second passivation layer over the first passivation layer, the second passivation layer being thinner than the first passivation layer; opening a plurality of via holes through the first and second passivation layers to the plurality of source-drain metal contacts; depositing a layer of conductive material over the plurality of source-drain metal contacts and the second passivation layer; depositing a first doped a-Si layer as an optically active layer over the layer of conductive material; patterning the first doped a-Si layer and the layer of conductive material to form collection electrodes . . . ." Which of the layers in Ishaque corresponds to the first passivation layer and the second passivation layer? As claimed in claim 7, the first passivation layer is deposited "over the plurality of source-drain metal contacts and the substrate." Further, the second layer, according to that claimed, is the layer closest to the optically active silicon. In other words, the only potentially conceivable way that the passivation layers shown in the figure of Ishaque can be interpreted to even partially correspond to the claimed first passivation layer and second passivation layer is if the first passivation layer corresponds with layer 134 (which is in contact with the source-drain metal contact of Ishaque) and the second passivation layer

corresponds with layer 132 (which is closest to the optically active silicon layer 120). Therefore, Ishaque does not teach that the first passivation layer is thicker than the second passivation layer, it teaches the opposite.

The Examiner further remarks that

> Applicant further argues that there is no motivation to use the dual passivation layer of Ishaque in the device or method of the admitted prior art. This is not persuasive. Multiple valid motivations were explicitly provided in the rejection that came from the prior art itself. Ishaque discusses various single layer passivation layers and the advantage and drawbacks of each. Ishaque then discusses that the dual layer passivation relied upon in the rejections above satisfies all the requirements for the passivation layer and thus is advantageous for providing all the motivations or advantages simultaneously.

As discussed in further detail above, the Examiner has pointed to five purposes for the passivation layer. (*See* Ishaque, col. 2, lines 3-31). However, Ishaque then states that a single passivation layer has "been found to provide a satisfactory passivating layer with regard to several of the desirable characteristics listed above." (Ishaque, col. 2, lines 33-36). The only drawback listed is that "polyimide passivating layers include the poor moisture barrier provided by polyimides." (Ishaque, col. 2, lines 37-38). Therefore, instead of a multitude of reasons to combine, as suggested by the Examiner, Ishaque only stated one -- to provide for a better moisture barrier. The reason why the device taught in Ishaque needed a better moisture barrier was because the barrier layer partially encapsulated the device and was open to atmospheric conditions. As discussed above, one skilled in the art would not be motivated to add a second passivation layer into the AAPA to provide for a moisture barrier. This is especially true because the passivation layer in the AAPA is embedded within the device and is not exposed to atmosphere. The passivation layer in the AAPA therefore has no function of protecting the device from atmospheric conditions.

The Examiner further states that

> Applicant's argument that a moisture barrier is not needed is not persuasive. Applicant asserts that one skilled in the art would resist a good moisture barrier because of the desire not to trap moisture in the device. Applicant's arguments do not constitute evidence on record and thus is mere allegation. This allegation is unproven or supported by any evidence and is thus not persuasive to overcome the *prima facie* obviousness of the rejection. Further, it is noted that the passivation layer of Ishaque is comprised of the same materials as in the instant invention (BCB and oxides as recited in claims 8, 9, 12, 13, 17 and 18 of the instant application), thus if the passivation layer of Ishaque would trap moisture in the device (an alleged disadvantage or undesireable effect), then applicant's invention would also include this undesirable characteristic.

The Examiner has not provided a *prima facie* case of obviousness since the Examiner has not shown that providing a moisture barrier inside the device claimed by Applicants would have desirable features to one skilled in the art or that Ishaque's barrier layer would function as a barrier layer when embedded within the device described in Applicant's AAPA. The passivation layers disclosed and claimed by the Applicants are not exposed to atmosphere, instead being embedded within the device. Therefore, a moisture barrier (who's only purpose is to protect the device from atmospheric moisture) has no function in that context. Therefore, the dual barrier layer structure as taught by Ishaque would not function as intended by Ishaque (i.e., to protect the device from atmospheric moisture) when embedded in Applicant's claimed structure.

Conclusion

In view of the foregoing amendments and remarks, Applicants respectfully request reconsideration and reexamination of this application and the timely allowance of the pending claims.

Please grant any extensions of time required to enter this response and charge any additional required fees to Xerox Deposit Account 24-0037.

Respectfully submitted,

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Dated: September 1, 2006

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